Hi, I'm Greg. I'm a NYC tutor! I love helping students. I tutor many subjects, assist with homework help, etc. I mainly specialize in specialized tests.

As it turns out, I haven't been able to get to do as many livestreams as I have in past years (yet, hopefully that changes). Therefore, I thought it would be fun to start a Problem Of The Day Series. I will put up a problem and leave it running for a while. You guys will then analyze it, and come up with possible solutions and alternative solutions on your own. I'll eventually post the answer in some manner.

For now we'll play it by ear how that will happen and for how long I'll leave up a problem. But right now I'm thinking of keeping the problem up maybe 2 hours minimum and maybe even in some cases 4 or 5 hours depending upon the dynamics and my situation. Unlike my AMA (Ask Me Anything) lifestream sessions, I will not be checking in every few minutes although I may from time to time join into the discussion. Again, the idea is for you guys to discuss out the problem.

Please be respectful to each other in this endeavor and let's make this fun, educational and forward-thinking. Keep the comments within the spirit of what I’m doing here. Please email me at GregsTutoringNYC@gmail.com if needed.

HERE’S THE PROBLEM: <————
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A frozen solid cube of peanut butter with side length 8 just fits perfectly into an enclosed cylinder. Assuming pi is 3.14, how much jelly needs to be added to fill all the remaining available space inside the cylinder?

HERE’S THE SOLUTION:
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If a cube just fits perfectly it means the height of the cylinder must be the same as the height of the cube.

.: The height of the cylinder is also 8.

If a cube just fits perfectly, it means each vertex of the cube meets the edge where the cylinder's base meets the the cylinder's curved surface — in other words where the vertexes of the square would meet the circumference of the base, therefore, at 4 points on the “top” and 4 on the “bottom” of the cylinder.

Looking down from the top, this looks as a square inscribed in a circle, in our case fitting into/filling out the cylinder's face perfectly and both having the same center.

Under this situation, the length of the diameter of the circle is the same as the length of the diagonal of the square.

We can use the Pythagorean Theorem to calculate the diagonal as we know the length of the side of the square is 8.

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.: c^2 = a^2 + b^2
       = 8^2 + 8^2
       = 64 + 64
       = 128
    \|(c^2) = \|128    (Note: \| means square root)
    c = \|128
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Let's simplify \|128:

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   \|128 = \|64 x 2 = \|64 x \|2 = 8\|2
   (this kind of unravels what we just did to compute c, but so be it)
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Note: If you knew your Pythagorean Triples, you could have also noticed that the square with the diagonal through it inscribed in the circle establishes an isosceles triangle in particular one with 45 degree angles for the angles that are not 90 degrees. This triple is a “1-1-\|2” right triangle, and in our case with a factor of 8 therefore giving us 8-8-8\|2, the latter value of which we just computed above.

Ok, now we know the diagonal is 8\|2. As this value is also the diameter of the circle establishing the base:

.: r = d/2 = 8\|2 / 2 = 4\|2

Now we have everything we need to get the volume of the cylinder and the volume of the cube, and subtract them!

.: Vcube = s^3 = 8^3 = 512

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.: Vcylinder = pi x r^2 x h
             = pi x (4\|2)^2 x 8
             = pi x (16 x 2) x 8
             = 256 pi = 256 x 3.14 = 803.84
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.: 803.84 - 512 = 291.84

Now get out the jelly! 🍞🍴

- Greg / GregsTutoringNYC@gmail.com   LLAP ☮